**Escape from the Lair of the Evil Dr. Gasz - Chemistry CTR**

Ministry Requirement: *F2.3 solve quantitative problems by performing calculations based on Boyle’s law, Charles’s law, Gay-Lussac’s law, the combined gas law, Dalton’s law of partial pressures, and the ideal gas law [AI]*

The CTR is organized like a miniature ‘Mission Impossible’ game. The students have been captured by the evil ‘Dr. Gasz’ and he has put them in a box filled with gas. In order to escape, they must determine aspects of the gas as Dr. Gasz changes them.

The students will be assigned into **groups of 3** and as a team they must escape the lair. They will be given their first clue on a sheet of paper along with their first puzzle piece. They will have to answer it correctly to get their second clue and a puzzle piece. Each puzzle piece will have some text on it that together forms the final riddle. The pieces are cut from a sheet in a way that makes it difficult to guess at the answer until close to the end of the riddle.

Piles of questions and their corresponding puzzle pieces should be placed at the front of the room with the name of the previous question’s law in front of them. A student from the group must come to the front of the room and tell the teacher the correct answer and the law which was used. If the teacher says this is correct, the students may take the next clue and piece from the pile.

Once the students have finished the all questions and solved the riddle, they may come to the front of the room to the computer and enter the password (answer to the riddle). They may only come once they are done the questions and assembled the puzzle. If a student has entered an incorrect password, they must return to their group before trying another password.

To add to theatrics of this game, the teacher can really delve into the introduction with Dr. Gasz, use exciting ‘spy’ music, and the teacher can use the ‘password’ excel worksheet (instructions attached). Also, a large visual timer can be projected on the screen to add to the sense of urgency and excitement.

The student questions and riddle are contained on the attached document. It is suggested that the riddle be cut up into interesting shapes as to make the puzzle more difficult to solve. Also, if the edges of the printed page are cut off in different shapes, it will be more challenging.

**Materials:**

Pre-cut clues

Pre-cut puzzle pieces.

**Theatrical Elements:**

Countdown clocks

<http://countdown.onlineclock.net/> (for added effect)

<http://www.youtube.com/watch?v=NMi_IJOsS1c> for final 20 second countdown

Exciting Music

Mission Impossible Theme Song

James Bond Theme song

Matrix Fight Music

300 Fight Music

Password Screen

‘ENTER PASSCODE” You can use the CTR Passcode excel sheet for added ‘solving’ effect. It gives students a box to type in your ‘password’ then you have a message that says either ‘accepted’ or ‘error’

Type the correct password into cell A1. It is ‘hidden’ and will thus be invisible. The If the entered password perfectly matches your password, the students will see a green ‘accepted’, otherwise it will say ‘error’ and turn red.

**Questions:**

1. Hello puny agents. It is I, Dr. Gasz, your arch-nemesis!! I just trapped you in a 2 x 2 x 2 metre room with a pressure of 75kPa. I just shrunk the room to half the size. What is the current pressure? Muahahaha!!!!

2. Oh, so you thought that was easy? Let’s turn up the heat. You just got yourself a thirty-six degree temperature increase from your once-comfortable 27˚C. Let’s see how you like it now!! What is the pressure??

3. Well, so you got through that hurdle, but I am shrinking the room even further. Now it is only 1.8m3!!! What is your temperature?? Burning up?

4. So, you think you could survive all that? Let me tell you. You better get this one. One of the members of your group may not be who they said they are. How many moles (of gas) are in the room right now?? (Note: R = 8.31 J/Kmol, kPa must be converted to Pa)

5. Well, agents, seems like you are managing to avoid my many obstacles. No fear, I just added a 0.2m3 container of 450kPa of NERVE GAS! See if you can handle it! What is the pressure now? Muahahaha

6. Oh no, it seems like you’ve gotten past my gas traps. There is no way you will ever find out the secret passcode to escape the facility. Beware of the countdown clock. Time to die!!!

**Answers:**

1. **Boyles Law – P1V1 = P2V2**  P = **150 kPa**
   1. V1 = 8m3
   2. P1 = 75 kPa
   3. V2 = 4m3
   4. P2 = ?
2. **Gay-Lussac’s Law – P1T2 = P2T1**  **P = 168 kPa**
   1. P1 = 150 kPa
   2. T1 = 27˚C + 273 = 300K
   3. P2 = ?
   4. T2 = 27 + 36 + 273 = 336K
3. **Charles’ Law – V1T2 = V2T1**  **T = 151.2 K**
   1. V1 = 4m3
   2. V2 = 1.8m3
   3. T1 = 336 K
   4. T2 = ?
4. **Ideal Gas Law – PV = nRT n = 240.55 mol**
   1. P = 168 kPa = 168000 Pa
   2. V = 1.8m3
   3. R = 8.31J/molK
   4. T = 151.2 K
5. **Dalton’s Law of Partial Pressures PTotal = P1 + P2 … P = 218 kPa**
   1. P1 = 450 kPa
   2. P2 = ?
   3. V1 = 0.2m3
   4. V2 = 1.8m3
      1. P1V1 = P2 V2, get P2 (50kPa)
      2. Ptotal = P1 + P2 = 168 + 50kPa

Riddle:

**A blue house is made of blue bricks. A yellow house is made of yellow bricks. A red house is made of red bricks. An orange house is made of orange bricks. What would a green house be made of?**

**The answer is GLASS**

(Get it? A greenhouse (such as the one used for plants) is made out of glass)